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The Variable Star R Centauri. By Alex. W. Roberts, D.Sc.

The southern variable star *R Centauri* (Ch. 5096) is a very fine example of a distinct and well-defined type of long-period variation, the type where each full light period consists of a double maximum and double minimum.

There are long-period variables that exhibit no secondary phase whatever, their variation being very regular.

For example, *S Sculptoris*, *U Centauri*, *R*, *V Sagittarii*, *U Pavonis*, and *T Pavonis* belong to this type.

There are also stars that exhibit secondary phases at frequent but irregular intervals. A good example of this class is the southern variable L_2 *Puppis.*

There are, however, a few stars where the secondary phases occur with marked regularity as regards period, but some irregularity as regards magnitude. Of this class of long-period stars *R Centauri* is, I think, the best example among southern variables.

The variation of *R Centauri* was discovered by Gould in 1871.

From the date of its discovery till 1878 the star was under more or less regular observation at Cordoba. On this series of observations Dr. Gould remarks, *U. A.* p. 269 :—

"The observations might be reconciled by supposing a full period of 525 days, with epoch of principal maximum 1871 April 18, and two intermediate maxima following the principal one by 197 and 378 days respectively.

"But this is incompatible with the estimates $6\frac{1}{4}^{m}$ and 6^{m} made 1874 June 25 and 26 during observations made with the meridian circle."

Although Gould's period is somewhat in error, yet he recognised the peculiar nature of the star's variation.

R Centauri has been under observation at Lovedale since 1891, and during that time six principal and five secondary maxima have been determined.

Several secondary maxima have also been observed. The principal minima, however, as they fall as low as the 13th magnitude, are beyond the reach of the telescopes at my disposal, and so the dates of this phase have been obtained by estimation only from examination of the light curve.

The magnitudes at principal maxima, while on the average $0^{m}\cdot4$ brighter than the average of secondary maxima magnitudes, are singly sometimes fainter than the preceding maximum.

Thus the secondary maximum of 1900 April 5 is $6^{m}\cdot1$, but the following primary maximum of 1900 November 12 is only $6^{m}\cdot4$.

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The dates of principal maxima observed either at Cordoba or at Lovedale are as follows :—

		Mag.	Res.
Cordoba	1871 April 15	6·1	$+11^{\mathrm{d}}$
,,	1872 Sept. 30	6·0	−25
,,	1877 Aug. 3	>6·4	+33
Lovedale	1891 July 10	6·6	+ 5
,,	1893 Jan. 10	5·3	−13
,,	1894 Aug. 15	6·0	+ 2
,,	1896 Mar. 12	5·8	+ 7
,,	1899 April 15	5·7	− 1
,,	1900 Nov. 12	6·4	+ 6

These dates yield a period of

568·5 days,

and for the epoch of principal maxima

1900 November 6.

The dates of secondary maxima are :—

		Mag.	Res.
Cordoba	1872 April 20	6·7	$+2^{\mathrm{d}}$
,,	1878 June 28	6·1	−10
Lovedale	1892 June 11	6·0	−25
,,	1894 Feb. 10	6·6	+24
,,	1895 Sept. 2	6·5	+17
,,	1898 Sept. 27	6·5	+ 2
,,	1900 April 5	6·1	−11

These yield a period of

568·0 days,

and for the period of secondary maxima

1900 April 16.[1]

The residuals between the observed and computed dates are given in the last column of both tables. It will be evident that they are not excessive, considering the duration of a full cycle of variation.

A secondary minimum ($8^{\mathrm{m}}\cdot 7$) was observed by Gould 1872 August 3. The last secondary minimum observed at Lovedale was 1900 July 28 ($8^{\mathrm{m}}\cdot 4$).

A comparison of these two dates yields a period of

567·8 days.

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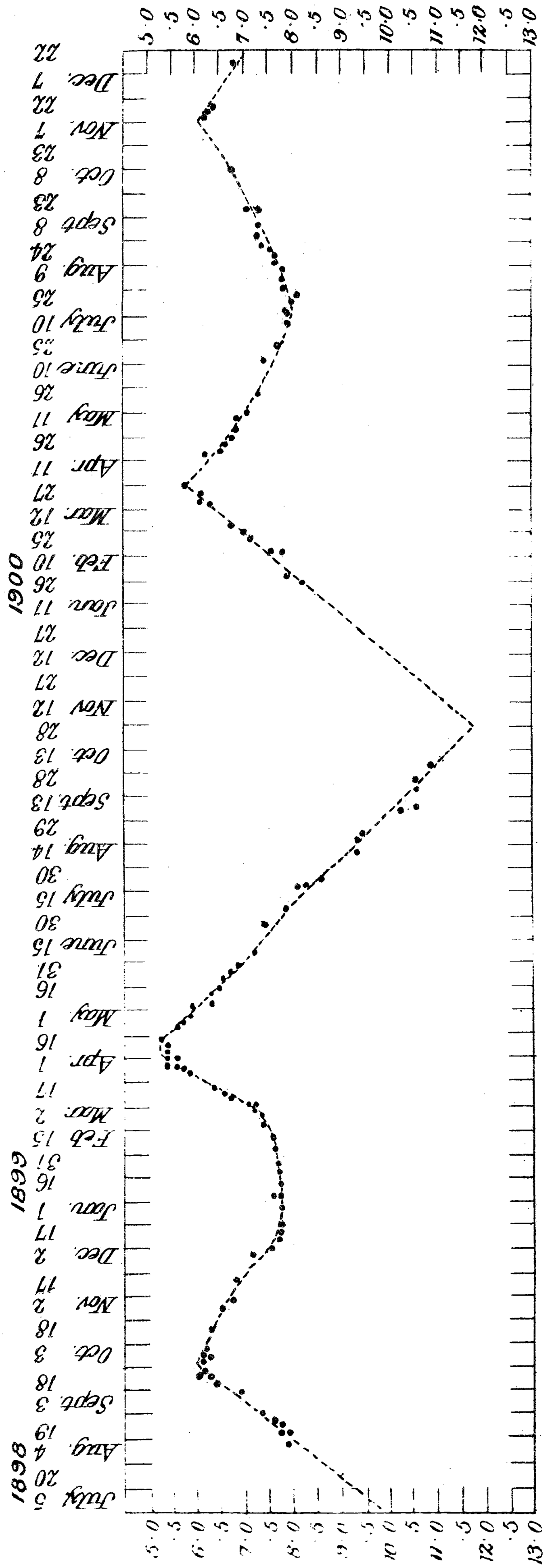

Light Curve of R Centauri (Gr. 5096), 1898, 1899, 1900.

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The full period of *R Centauri* may, therefore, be thus determined :—

From principal maxima, $568^{\mathrm{d}}{\cdot}5$, weight 3
secondary maxima, 568·0, weight 2
secondary minima, 567·8, weight 1

Mean period ... 568·2

The full elements of the star's variation may be thus tabulated :—

Period	$568^{\mathrm{d}}{\cdot}2$
Chief minimum	*J.D.* 1,414,964
Secondary maximum	5126
Secondary minimum	5228
Principal maximum	1,415,330

The two maxima follow one another at intervals of 204 and 364 days respectively, instead of 197 and 378, as Dr. Gould has it.

The period found by Dr. Gould, 525 days, is evidently due to a slip in addition, as the two combined intervals give 575 days.

Both from the Cordoba observations and the Lovedale observations there is evidence that the star at its lowest minimum sometimes reaches the 13th magnitude. To exemplify as clearly as possible the nature of the variation of *R Centauri*, the observations made at Lovedale in the years 1898–1900 have been charted down in Plate 10. During this period two full cycles have been nearly completed, and the general type of the variation can be readily seen from an examination of the light curves. In the 1898–99 period the principal maximum is distinctly brighter than the secondary maximum. The form of the light curve also between the two maxima is somewhat irregular. In the 1899–1900 observations the principal and secondary maxima are practically equal, and the form of the light curve is very regular.

The rise either to principal or secondary maximum is not markedly more rapid than the descending rate. While a rapid ascent to maximum is a characteristic of all short-period variables, it is by no means a general rule with regard to long-period variation. Indeed, there are instances where an opposite law—a more rapid decline to a minimum—seems to govern the variation of the star's light.

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On the Observation of Position Angles of Polar Double Stars.

By R. T. A. Innes.

The coordinates of an equatorial telescope do not, in general, coincide with those of the sky. Error is thus introduced into measures of position angle determined with the micrometer adjusted to the instrument. This question has been considered by Chauvenet (vol. ii. pp. 393, 394), but the formula he arrives at is not adapted for use in practice. In the case of stars some distance from the pole the instrumental errors are wholly eliminated by allowing the stars to travel along the wire by diurnal motion, and so refer the zero of the position circle to the sky itself. This method was even adopted in the case of *Polaris* by Otto Struve (Pulkowa Observations, vol. ix. p. 10). Experiments show that this is a very tedious method in the case of polar stars, and one requiring repeated observations to secure accuracy. The following method is both extremely simple and accurate :—

Set on the polar star to be measured; find the instrumental zero of the micrometer position circle by moving the telescope in declination by the slow-motion handle; then determine the star's position angle and add to it the instrumental hour angle less the real hour angle (in arc).

The rationale is as follows :—

Adopting as far as possible Chauvenet's notation (vol. ii. p. 375) we have

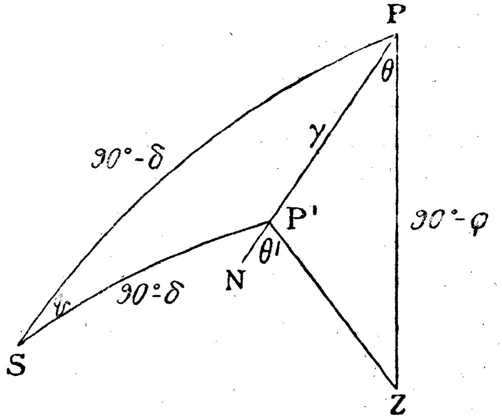

Fig. 1.

P = pole of sky
S = star
ZPS = τ = hour angle of star
PS = 90° − δ = polar distance of star
ZPP′ = θ
PP′ = γ
PZ = 90° − ϕ = colatitude
P′PS = $\tau - \theta$
Po = observed position angle

P′ = pole of instrument
Z = zenith
ZP′S = t' = instrumental h. angle of star
P′S = 90° − δ' = instrumental p.d. of star
ZP′N = θ'
PSP′ = q
ϵ = spherical excess of the triangle PSP′
PP′S = 180° − SP′N = 180° − $(t' - \theta')$
p = true position angle = $P_0 + q$